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COMMITTEE ON THE PEACEFUL
USES OF OUTER SPACE

IMPLEMENTATION OF THE RECOMMENDATIONS OF THE SECOND UNITED NATIONS CONFERENCE ON THE EXPLORATION AND PEACEFUL USES OF OUTER SPACE

International cooperation in the peaceful uses of outer space: activities of Member States

Note by the Secretariat

Addendum

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*This document has not been formally edited.

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INTRODUCTION

1. In accordance with a recommendation of the Committee on the Peaceful Uses of Outer Space at its thirty-seventh session, Member States have submitted information on the following topics:[1]

(a) Those space activities that were or could be the subject of greater international cooperation, with particular emphasis on the needs of the developing countries;

(b) Spin-off benefits of space activities.

2. The information on those topics submitted by Member States as of 30 November 1994 is contained in document A/AC.105/592.

3. The present document contains information on those topics submitted by Member States between 1 and 31 December 1994.

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[1] Official Records of the General Assembly, Forty-ninth Session, Supplement No. 20 (A/49/20), para. 29.

REPLIES RECEIVED FROM MEMBER STATES

HONDURAS

[Original: Spanish]

In Honduras, under the national Constitution, the National Autonomous University of Honduras is an autonomous institution of the State, which is a juridical entity and enjoys the exclusive right to organize, direct and develop advanced and professional education. It is to participate in scientific, humanistic and technological research, in the general dissemination of culture and in the study of national problems. It is to plan participation in the transformation of Honduran society.

The National Autonomous University of Honduras (UNAH) has, since the beginning of the 1990s, been promoting the development of basic space science, particularly as regards the establishment of astronomy and astrophysics, with a view to helping to raise the scientific and technical level of the country and the region, as well as to afford new opportunities for individual development.

UNAH has been active along a number of lines as part of a strategy to establish astronomy and astrophysics as professional fields in the country. These include:

(a) Promotion of the project for an astronomical observatory for Central America;

(b) Organization of the Assembly of Central American Astronomers and Astrophysicists;

(c) Establishment of the astronomical observatory of the National Autonomous University of Honduras (OA/UNAH);

(d) Preparation of a training programme for astronomers and astrophysicists for Central America;

(e) Organization of the first Central American course on astronomy and astrophysics;

(f) Participation in international events relating to basic space science;

(g) Development of communication with international agencies concerned with outer space matters.

Under the project for an astronomical observatory for Central America, UNAH focuses on the need to open an astronomical observatory equipped with new information, electronics and astronomical technologies for the use and benefit of Central Americans, as a means of helping to improve some essential aspects of their lives and to narrow the scientific and technological gap that separates us from the industrialized countries.

The project document lays the bases for establishment of the astronomical centre, including:

- Selection of the site for the astronomical observatory by means of prospecting trials;
- Designs for the observation system, its electronics and computation systems, and the buildings and access;
- Training of scientific and technical personnel in basic space science within the Central American area;
- Provision of basic astronomical services to countries.

The financial support, and also the operation of the research centre, are considered in the context of permanent international cooperation to maintain:

- A critical mass of astronomers constantly producing scientific results in the region;
- A place where the international community can come to carry out observations;
- An infrastructure through which the Central American countries can enter and remain in the space age,

with a view to participating in regional and world astronomical and space programmes.

This project was prepared in Spain as part of a sabbatical leave by the Head of the Astronomy Section of UNAH. It has been technically reviewed in scientific institutions such as the Astrophysics Institute of the Canaries, the Hispano-German Astronomics Centre, the Astrophysics Institute of Andalusia, and other observatories and scientific research centres.

The Assembly of Astronomers and Astrophysicists of Central America has been constituted as a regional body of the Central American universities and other specialized scientific institutions which wish to contribute to the development of all aspects of astronomy and astrophysics by means of ongoing international cooperation.

The first Assembly took place in 1993, at Tegucigalpa, Honduras, sponsored by the National Autonomous University of Honduras. It was attended by representatives of the national universities of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama. The noteworthy results of the Assembly, apart from the desire to continue with the initiative, were support for the project for an astronomical observatory for Central America and the decision to seek accession by the Central American countries to the International Astronomical Union.

The second Assembly took place in 1994, at San José, Costa Rica, sponsored by the University of Costa Rica, the Latin American Physics Centre and the European Space Agency. It was attended by representatives of the national and private universities of Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama, and of the European Space Agency. In addition to the presentation of a number of scientific papers, there was a notable support for the initiative to develop a training programme for Latin American astronomers and astrophysicists, in cooperation with Spanish universities, and also an awareness of the need to seek urgently means of connecting ourselves over an international satellite communications network such as the Internet.

It is hoped to hold the third Assembly in 1996, this time in San Salvador, El Salvador. Currently, for the period 1994-1996, the chairmanship of the Assembly is held by the representative of Honduras and the secretaryship is held by the representative of El Salvador.

In 1994, the authorities of the National Autonomous University of Honduras approved the establishment of the University's astronomical observatory as an academic unit under the University Centre for General Studies, responsible for:

(a) Carrying out observation and scientific research projects in the field of astronomy and other related areas;

(b) Managing and developing instrumentation facilities for observation, reduction and analysis, and for receiving astronomical images;

(c) Providing basic astronomical services to students at the university and other educational levels and to the general public;

(d) Organizing and coordinating activities for the dissemination of astronomical knowledge, collaboration in the teaching of astronomy at university level and training of scientific and technical personnel in all fields related to astronomy and astrophysics.

At the present time, OA/UNAH is the only astronomical observation and research centre operating at a Central American university.

OA/UNAH has its own resources and its own staff. It has a fully computerized main telescope with a 42-cm primary mirror, a CCD chamber and other instruments. It is available to the national and international scientific community or to anyone who submits an application for an observation project and receives permission from the Time Allocation Committee. It is also open to the public and it is carrying out its own observation and research projects, including:

(a) A study of the astronomical quality of the sky over Honduras;

(b) Teaching of astronomy in Honduras;

(c) History of astronomy in Honduras;

(d) A morphological study of the Sun;

(e) The solar system;

(f) Variable stars.

As part of the teaching programme, such courses as the following are given: a seminar on selected topics in astronomy, spherical astronomy and general astrophysics. As regards basic astronomical services, work is being done on calculation of astronomical ephemerides; lectures and talks are given and exhibitions and visits with the telescope are arranged to different schools in the country.

OA/UNAH has been organized as the Honduran counterpart for the regional project for an astronomical observatory for Central America.

The training programme for astronomers and astrophysicists for Central America is a Master's programme intended to form, through international scientific cooperation, a body of professionals in astronomy and astrophysics responsible for bringing the Central American isthmus into the fields of research and of knowledge, use and application of astronomical instrumentation and space technology, at the same time creating the basic infrastructure for carrying out the teaching and research activities required in each of the countries.

Through the different courses, the students will be given adequate background in physics, mathematics, astronomy, astrophysics and instrumental techniques so that graduates can continue with doctoral courses with no difficulty and so that they can promote the teaching of astronomy and astrophysics as fields of specialization in their own countries.

The basic subjects comprise classical astronomy and celestial mechanics, stellar, interstellar, galactic and extragalactic astronomy and cosmology; various astrophysical instrumentation techniques, together with

appropriate physico-mathematical support and laboratory, computer and astronomical observation techniques, as well as seminars on a variety of subjects which supplement the content of the courses.

In order to develop this project, in the current year, visits were paid to the various Central American universities, and an agreement on international cooperation between the University of La Laguna, in Spain, and the National Autonomous University of Honduras was signed. The terms of reference of this agreement include, as priority areas of cooperation, astronomy and astrophysics, physics, meteorology, mathematics and information technology. The objectives of cooperation refer to:

(a) Contributing to the development of a regional training programme for astronomers and astrophysicists for Central America;

(b) Implementing joint research projects;

(c) Contributing to the establishment of an astronomical research centre.

The first Central American course on astronomy and astrophysics is being organized for early 1995, to:

(a) Provide an updated view of some relevant topics of astronomy and astrophysics;

(b) Promote an exchange of experiences and interinstitutional work between students and professionals in the area of astronomy and astrophysics.

The topics to be covered in the course are: the solar system, solar physics, the atmospheres, surfaces and interiors of the planets and their satellites, structure of stars, galaxies and observational cosmology, and astronomical instrumentation. Some topics of archaeoastronomy will also be included.

It is hoped that advanced students in physics or related disciplines, or professionals in these disciplines, who do not, however, have much knowledge of the subjects to be covered by the course, will take part in it.

This course, which will take place in Honduras — the first part at Tegucigalpa in the astronomical observatory of the National Autonomous University of Honduras, and the second in the city of Copan Ruinas, the ancient astronomical centre of the Mayan civilization — is being organized by an international committee consisting of professors from Colombia, Costa Rica, Honduras and the United States of America.

As regards participation in various international events related to basic space sciences, in addition to presenting specific scientific projects, the project for an astronomical observatory for Central America has been promoted at these events as a realistic way of developing basic space science in the developing countries. Among the most important events attended, the following deserve special mention:

In 1993: (a) the first Assembly of Central American Astronomers and Astrophysicists (Tegucigalpa, Honduras); (b) the second Space Conference of the Americas (Santiago, Chile); (c) the third United Nations/European Space Agency Workshop on Basic Space Science for Developing Countries (Lagos, Nigeria); (d) the first Central American meeting of astronomics associations (Antigua, Guatemala).

In 1994: (a) the second Assembly of Central American Astronomers and Astrophysicists (San José, Costa Rica); (b) the fourth United Nations/European Space Agency Workshop on Basic Space Science for Developing Countries (Cairo, Egypt); (c) the Seminar on the Development of Science and

Technology in Central America: Plans and Strategies (San Salvador, El Salvador); (d) the Second Central American Congress of Associations of Amateur Astronomers (San Salvador, El Salvador).

During the whole period, an effort has been made to promote communications with international bodies such as the United Nations Office for Outer Space Affairs, at Vienna. For this purpose, in addition to participating in the different Workshops on Basic Space Science for Developing Countries organized by the United Nations and the European Space Agency, regular reports have been sent on the astronomical activities of the National Autonomous University of Honduras.

In this connection, the opinion that the National Autonomous University of Honduras sent to the Interim Secretary of the second Space Conference of the Americas, on the proposed agenda for the third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE), to be discussed at Vienna, on 21 February and 4 March of this year, at the session of the Scientific and Technical Sub-Committee of the Committee on the Peaceful Uses of Outer Space (COPUOS), deserves special mention.

MOROCCO

[Original: French]

Morocco's interest in the uses of outer space dates back to the 1970's, particularly as regards space communications and remote sensing.

Morocco believes that the effective application of space techniques in a developing country is a task that requires an active policy at both the national level (generation of awareness, coordination, training, and project formulation) and the international level (participation in forums, international committees, and bilateral and multilateral projects). This report summarizes the Kingdom's recent space-related activities.

I. APPLICATION OF SPACE TECHNIQUES

I.1. Application of remote sensing

I.1.1 Organization

The history of spaceborne remote sensing for practical applications began in 1972 with the launching by the United States of the LANDSAT Earth observation satellite. Since then, different ministries and universities have equipped themselves to use this technique and have undertaken the training of the necessary staff.

The Royal Centre for Spaceborne Remote Sensing (CRTS) was established in 1989 to promote, develop and coordinate spaceborne remote sensing activities at the national level. It is also responsible for distributing satellite images to users, for storing data, for assisting in training and research in this field, and for representing the Kingdom abroad.

Pursuant to a decision of the Prime Minister, the National Commission for Spaceborne Remote Sensing was set up in 1993, bringing together the ministerial departments with an interest in this technology and in geographic information systems (GIS).

Morocco today has a national network of remote sensing and GIS operators and users along with a broad range of modern and appropriate equipment.

1.1.2. Data acquisition and distribution

With a view to facilitating the acquisition and distribution of space-relayed images in the Kingdom, CRTS has established contacts with a number of satellite image distributors: Spot Image in France for SPOT data, Eurimage in Italy for LANDSAT, NOAA, ERS, etc.

In addition, several stations are currently in operation to receive METEOSAT weather satellite data in Morocco. Plans call for CRTS and the National Department of Meteorology to set up two NOAA stations.

1.1.3. Applications and projects

A number of projects combining spaceborne remote sensing and GIS are in the process of implementation or development. These projects are designed to address requirements in the areas of natural resource stocktaking and management, environmental protection and territorial development within the context of national development programmes:

- In the area of town planning, the large cities have benefited from a number of applications in response to the rapid evolution of the urban fabric and the need for steadily updated information on the changing situation on the ground. These applications also make it possible to analyse the changing shape of the cities. The methods that have been devised are particularly well suited to the needs of developing countries.

- With regard to agriculture and forestry, several significant projects might be mentioned:

  - The national AGRIMA project (co-financed by UNDP) on the incorporation of satellite data in the country's agricultural statistics;

  - The implementation of the FORMA project (co-financed by the European Union) on the satellite surveillance of Moroccan forests.

- In the fields of cartography and marine environment monitoring:

  - Morocco is currently working on applications for lagoon management and beach mapping;

  - The national GERMA project (co-financed by the European Union) to develop a system, based on satellite images, for marine resource management is in the implementation phase;

  - Morocco has participated in Canada's airborne GLOBESAR campaign in advance of the launching of that country's RADARSAT satellite, and in that connection has initiated coastline and soil erosion research.

1.2. Telecommunication and position-finding applications

1.2.1. Telecommunications

In January 1970 Morocco put into operation Africa's first space telecommunication station. It currently operates three stations providing national and international circuits (the Mohammed V station at Rabat, a station at Laayoune and another one at Dakhla). It is a partner in the operation of the ARABSAT system and has signed a cooperation agreement with EUTELSAT for the satellite transmission and reception of television programmes, so that Moroccan television is now beamed via satellite. The country is also linked

over the international network to the INMARSAT system, and it is planned that an INMARSAT reception station will become operational in 1995.

I.2.1.1. Position-finding

A programme for locating and tracking ships at sea by satellite is under study. It involves two systems:

- A position-finding system;
- A transmission system.

The aim of this programme is to have in place four monitoring centres equipped to provide automatic position-finding and to exchange and transmit data, and also to establish the associated database. The position-finding and transmission functions will be performed by satellite.

II. INFORMATION AND TRAINING IN SPACE TECHNIQUES

II.1. Remote sensing

Seminars, exhibitions and information events have been organized on a regular basis in order to make decision makers, officials and scientists aware of the contributions and possibilities of remote sensing.

In 1994 the Moroccan Royal Centre for Spaceborne Remote Sensing (CRTS), in collaboration with the National Centre for Space Studies (CNES) of France, organized an exhibition on the uses of space. This event, which was very much a success, was attended by a large number of visitors, especially students. Other activities for young people have also been carried out, especially in the form of actively involving them in the European youth forum organized every year by the EURISY association.

In the area of ongoing training, short (one-week) and longer (two-week) courses at the regional level have been regularly organized by CRTS since 1993 to provide an introduction into the basic principles of spaceborne remote sensing, geographic information systems, and applications in areas of particular interest to the Kingdom and the region (agriculture, forestry, water resources, geology, town planning, territorial development, fisheries and oceanography). These courses are regularly attended by African participants in positions of responsibility.

By way of supplementing these training programmes, CRTS organizes training events specifically tailored to user requirements, arranges for courses in spaceborne remote sensing at the engineering colleges, and supports student researchers working in the area of remote sensing.

In addition, extended training courses in remote sensing are held for senior staff and student researchers at the Remote Sensing Centre of the Ministry of Agriculture and Agricultural Enhancement and at the Hassan II Institute of Agronomy and Veterinary Medicine.

II.2. Space technology. Microsatellite project

Morocco has formulated a project for a Moroccan microsatellite. A working group was established in 1994, bringing together representatives of all the Moroccan departments interested in this project. This group identified two main mission assignments for the microsatellite, namely:

- Telecommunications (data-gathering, position-finding and message-handling);
- Earth observation.

The working group's current mandate is to prepare these missions, in particular to define the requirements on board the satellite and on the ground and, subsequently, to scale the system and evaluate the costs.

In addition, the Mohammadia Engineering School (EMI) has continued its work in training the space team through participation in training seminars on space techniques and through internships at the Toulouse Space Centre of the National Centre for Space Studies in France. EMI has offered its candidacy as a site for a regional training centre in space sciences and techniques.

III. REGIONAL AND INTERNATIONAL ACTIVITIES

Morocco's involvement in regional and international space-related activities is noteworthy:

- Since 1992 it has been participating in the work of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS);

- Since 1993 it has been a member, through CRTS, of the Space Agency Forum (SAF) and is represented in the working group set up to evaluate the benefits to developing countries of the "Planet Earth Mission" programme sponsored by the Italian Space Agency,

- Since 1994 it has been a member, again through CRTS, of the EURISY association, which is working to promote teaching and information on advances in space technology and its applications.

With respect to international cooperation on behalf of developing countries, Morocco has been an active participant in the meetings organized by regional and international organizations, at which, in addition to helping to identify the needs of developing countries, particularly in Africa, it has proposed ways of encouraging the further use of these techniques on the continent:

- The workshop organized by EURISY and the Council of Europe at Strasbourg on training, where the Moroccan representatives submitted a report on "Spaceborne remote sensing and the developing countries: Training and the transfer of know-how from Europe to Africa";

- The United Nations International Astronautical Federation workshop sponsored by the European Space Agency and the European Community at Graz, at which Morocco presented a paper entitled "Geographic information: A need for the developing world";

- The Nairobi meeting on spaceborne remote sensing and the developing countries, organized by the European Community and ESA;

- The workshop organized by UNDP at New York on the application of information systems and technologies for sustainable human development.

Morocco has organized international events as part of the effort to promote scientific exchanges and North-South and South-South cooperation in the area of spaceborne remote sensing for the management of natural resources, the protection of the environment and the formulation of strategies of sustainable development.

In 1992, the International Space Year, Morocco, together with a number of international, regional and national agencies, organized MARISY 92, devoted to the African continent. The speakers at the opening ceremony of this international forum, which took place under the patronage of His Majesty King Hassan II,

were Crown Prince Sidi Mohammed and Prince Moulay Rachid. The event was a genuine success and brought together a large number of countries from Africa, the Middle East, Europe and North America.

As a follow-up to MARISY 92, MARISY 95 will have as its theme "Spaceborne remote detection for the environment and development", in the spirit of the recommendations of Agenda 22. Organized by the CRTS in collaboration with regional and international organizations (UNDP, ECA, FAO, MEDIA-IGBP, the African Organization for Cartography and Remote Sensing), the European Space Agency and a number of national space agencies - ASI (Italy), CNES (France), INTA (Spain) and SSTC (Belgium) - and with the participation of EURISY, this forum will take place at Rabat from 16 to 18 October 1995. It will bring together decision makers, financiers, industrialists and users for the purpose of demonstrating the practical applications of remote sensing in the service of sustainable development.

At the request of a number of countries, the Programme Committee has decided to open MARISY 95 to those countries of the Middle Eastern region that are engaged in interesting projects and whose environmental problems are similar to those of the African nations.

PORTUGAL

[Original: English]

The year 1994 has been characterized by the implementation of the National Space Science and Technology Programme, created by the Portuguese Government in 1993, following the successful launch of the first Portuguese satellite (POSAT-1) that took place in that same year.

In order to coordinate the implementation of such a national programme, a Task Force was created in July 1994. The eight members of the Task Force representing National Defence, Science and Technology, Planning, Industry and Telecommunications took office in August 1994.

In the last twelve months, the construction of a new satellite (POSAT-2) was initiated, and the development of national capabilities and expertise in several areas of the peaceful uses of outer space was carried out.

The role of the remote sensing satellite data continues to play a major role among:

- agricultural, forestry and fishery activities;
- use of GPS for geodesy purposes;
- basic and thematic cartography;
- study of upwelling phenomena; and
- sea water pollution characteristization.

This area of space applications has been the object of more intensive activity directly or closely related to international cooperation in the peaceful uses of outer space.

The development of the network of national remote sensing research groups and institutions continued to be implemented, as part of the network of geo-referenced data bases that link together cartographic data

banks, satellite imagery and statistical and descriptive types of information related to specific locations in the country within the scope of the National Geographic Information System (SNIG).

The implementation of cooperation activities with developing countries has been the object of high priority in a number of institutions that offer specific programmes for trainees from those countries in meteorology, oceanography, hydrography, geodesy and cartography, soils, agriculture and forestry; thematic cartography, natural resources management and environmental assessment.

RUSSIAN FEDERATION

[Original: Russian]

The space activities of Russia during 1994 were effected in accordance with the Federal space programme of exploration and use of outer space and also in the context of international scientific and technical cooperation and of commercial agreements.

During 11 months of 1994, 52 space objects of various kinds were launched including:

- 30 artificial satellites of the Cosmos series (Cosmos-2268 to Cosmos-2297)
- 3 manned spacecraft of the Soyuz TM series (Soyuz TM-18, Soyuz TM-19 and Soyuz TM-20);
- 5 unmanned cargo spacecraft of the Progress M series (Progress M-21 to Progress M-25);
- The Coronas-I unmanned station;
- 1 artificial satellite from each of the Gals, Gorizont, Ekspress, Meteor-3, Molniya-3, Nadezhda, Okean-01, Raduga, Raduga-1, Resurs-01, Foton, Elektro and Geo-IK series.

The above mentioned space objects were placed into orbit by 41 launches from Soyuz, Proton, Zenit, Cosmos, Molniya and Tsiklon type carrier rockets.

In the case of 3 launches of satellites in the Cosmos series, a number of satellites were placed into orbit by a single carrier rocket:

12 February - 6 earth satellites (Cosmos-2268 to Cosmos-2273);

11 April - 3 earth satellites (Cosmos-2275 to Cosmos-2277);

11 August - 3 earth satellites (Cosmos-2287 to Cosmos-2289);

20 November - 3 earth satellites (Cosmos-2294 to Cosmos-2296).

I. MANNED SPACE FLIGHTS

During 1994, crews from four Russian principal expeditions (the 14th, 15th, 16th and 17th) and two international crews (Russian-Western European and Russian-Kazakh) worked on the Mir manned scientific research station, operating in an Earth orbit since 1986.

The programme of work performed by the crew of the 14th principal expedition (cosmonauts V. Tsibliev and A. Serebrov) in the period from July 1993 to January 1994 comprised operations on basic trends in contemporary space science, including geophysics, astrophysics, space materials science, biotechnology and medicine.

During flight the cosmonauts effected five space walks, in the course of which they performed a number of essential operations on supplementing the orbital station with additional equipment and scientific apparatus. The total duration of operations in open space amounted to 14 hours, 12 minutes.

During the concluding stage of the work, cosmonauts of the 14th principal expedition worked in collaboration with the crew of the 15th principal expedition (cosmonauts V. Afanasev, Y. Usachev and V. Polyakov), who arrived at the Mir station on the Soyuz TM-18 craft.

The programme for the joint flight of the five cosmonauts included the conduct of a number of geophysical, medical and biotechnological experiments.

On 14 January, after completion of the programme involving a 197-day flight, cosmonauts V. Tsibliev and A. Serebrov returned to Earth on the Soyuz TM-17 craft.

The work of the 15th principal expedition, whose duration was 182 days, involved continuation of research and experimentation on geophysics, astrophysics, space materials science, biotechnology and medicine.

On 24 January the cosmonauts effected the transfer of the Soyuz TM-18 spacecrafts from the Kvant module to the communicating passage of the Mir station. This modification of the orbital station was carried out in order to permit further transport operations for supplying it with equipment and expendable stores making use of Progress unmanned cargo vehicles. The duration of independent flight by the Soyuz TM-18 craft amounted to one hour, 49 minutes.

In its concluding stage, the work of the 15th principal expedition was conducted jointly with the Russian-Kazakh crew (cosmonauts Y. Malenchenko and Talgat Musabaev, a citizen of the Republic of Kazakhstan) who had arrived at the Mir station on the Soyuz TM-19 craft. The programme for the flight of the four Russian cosmonauts and their Kazakh colleague included the conduct of scientific, technical and medical research and experiments, including projects prepared by experts of the Republic of Kazakhstan.

On 9 July cosmonauts V. Afanasev and Y. Usachev returned to Earth on the Soyuz TM-18 craft.

Over a period of 126 days the crew of the 16th principal expedition (cosmonauts Y. Malenchenko, T. Musabaev and V. Polyakov) carried out work as planned within the context of the Russian and Kazakh national space programmes, including research on geophysics, astrophysics, space materials science, biotechnology and medicine, and in addition two space walks were effected with a total duration of 11 hours, 4 minutes.

In the course of operations in open space on the working section of the Mir station, scientific apparatus was installed for the purpose of conducting experiments under the international flight programme, involving participation of an astronaut from the European Space Agency (ESA). Work on the external surface of the orbital station (including the Rapan hinged-grid truss) comprised the disassembly and installation of containers with samples of various structural materials which had been exposed for a long period under open-space conditions. The state of the external structural components of the orbital station was checked. A number of preventive maintenance operations were carried out.

During the last 29 days, the crew of the 16th principal expedition worked jointly with an international crew (cosmonauts A. Viktorenko, E. Kondakova and U. Merbold - an astronaut from the ESA and a citizen of the Federal Republic of Germany), who had arrived at the Mir station on board the Soyuz TM-20 craft. The flight programme of the six cosmonauts included scientific, technical, medical and biological research and experimentation.

On 4 November cosmonauts Y. Malenchenko, T. Musabaev and U. Merbold returned to Earth on the Soyuz TM-19 vehicle.

Work in orbit is being continued by the crew of the 17th principal expedition (cosmonauts A. Viktorenko, E. Kondakova and V. Polyakov). The programme of work for this expedition includes a wide range of experiments and research assignments using the various items of equipment and apparatus available on board the Mir station.

During 1994 operation of the Mir orbital station was ensured by five unmanned cargo vehicles of the Progress M series (Progress M-21 to Progress M-25), which docked with it on 30 January, 24 March, 24 May, 2 September and 13 November, respectively.

In addition, Progress M-23 was equipped with a returnable ballistic capsule. With its help containers of materials emanating from research and experiments conducted during the period of operation of the Mir station by the crew of the 15th principal expedition were delivered to Earth on 2 July.

On 3 March endurance testing of the unmanned cargo vehicle Progress M-17 were carried out, this vehicle spending 11 months in a circumterrestrial orbit under independent flight conditions.

II. APPLIED SPACE TECHNOLOGY PROGRAMMES

The first Gals satellite of the new-generation direct television broadcasting system was launched on 20 January. The satellite was developed on a joint State-commercial basis and is intended for further development of the Russian television broadcasting system and for international cooperation.

For ensuring operation of the long-range telephone and telegraph communication system and the transmission of television programmes to points on the Orbita network, and also for purposes of international cooperation, satellites of the Raduga-1, Raduga, Gorizont, Molniya-3 and Cosmos-2291 were orbited respectively on 5 February, 18 February, 20 May, 23 August and 21 September.

In accordance with the programme for the development of the communications and television broadcasting systems using Earth satellites, the first launch of a communications satellite of the Ekspress new generation was carried out on 13 October. This satellite is intended for long distance, regional and local telephone and telegraph communications, the relaying of radio and television programmes, the transmission of data on behalf of various branches and departments of the Russian Federation and the broadening of international communications capabilities.

To ensure the functioning of the Global Navigation Satellite System (GLONASS), used for navigation by civil aircraft and merchant and fishing vessels, 9 artificial Earth satellites of the Cosmos series were launched on 11 April, 11 August and 20 November.

For determining the position of vessels of the merchant and fishing fleets of the Russian Federation and also operations within the international satellite system for tracking and rescuing vessels and aircraft in distress (COSPAS-SARSAT), an Earth satellite of the Nadezhda series was launched on 14 July.

With the aim of deriving meteorological and heliogeophysical information and data on the radiation situation in circumterrestrial space, a satellite of the Meteor-3 series was launched on 25 January.

31 October saw the launch of the first Russian geostationary meteorological satellite Elektro intended for operational observation of large-scale hydrometeorological processes governing the weather on Earth, and for the collection and dissemination of information on the environment, including data on the weather in space. With the launch of Elektro the establishment of a global international satellite system of meteorological observations from a geostationary orbit, involving space facilities of the United States of America, the ESA and Japan, was completed.

For purposes of pursuing research on space materials science, a regular satellite of the Foton series was launched on 14 June. Over a period of 18 days experiments took place on board the satellite aimed at obtaining, under microgravitational conditions, semi-conductor materials, optic glass with variable index of change, biologically active substances, together with development of the technology for their experimental-industrial production.

In order to derive operational oceanographic data on the ice situation in Arctic latitudes, a satellite of the Okean-01 series was launched on 11 October. The equipment available on board makes it possible to perform synchronized surveying of the subjacent surface by all the remote-sensing instrumentation in an integrated band (470km), at any time of day and even when cloud cover is present. The radar installation effects full coverage for a radar survey of the polar regions during a period of three days, which represents its principal advantage for operational research purposes in comparison with existing (including foreign) satellite radar installations with synthesized aperture, having a narrow viewing band of 40-100km. The satellite was launched to the order of the Russian Space Agency (RSA) on behalf of the Russian Federal hydrometeorological and environmental monitoring service.

For continuing research on the natural resources of the Earth, ecological monitoring and operational observations on behalf of the national economies of Russia and the other countries of the CIS, a regular Resurs-01 satellite was launched on 4 November.

III. RESEARCH PROGRAMMES ON OUTER SPACE

For more than seven years the Roentgen international observatory has been successfully operating in orbit as part of the Mir station. In 1994 its telescopes were used for conducting a series of observations of powerful X-ray sources in the constellations of Hercules and Scorpion and in the Crab nebula. A series of surveys of the essential parts of the Galaxy was carried out, in the course of which fresh information was obtained on one of the most powerful sources of X-ray radiation - the star X-1 Cygni - and two new sources of X-ray radiation were discovered. Detailed research is in progress on the energy spectra of X-ray sources appearing in the radio range as objects moving at superluminary velocities.

A programme of flight experiments is being successfully conducted at the Granate orbital observatory. During five years of operation a detailed study has been made of several tens of galactic and extra-galactic sources, representing possible black holes, neutron stars (X-ray bursters and X-ray pulsars), X-ray novae, and accumulations of galaxies and quasars; twelve extremely interesting and hitherto unknown objects have been discovered. For the first time three sources emmitting radiation in the annihiliation gamma line of positronium have been localized.

At present (as from 1 October 1994) the observatory is operating in the scanning regime. It is expected that during a year of operation in this regime a detailed map of the entire skies in the hard X-ray range will be obtained. An X-ray nova burst was observed in November 1994.

An extensive programme of scientific, technical, technological and other research and experiments was conducted in the course of manned flights by Russian cosmonauts on board the Mir station.

Thus, in order to produce data assisting the study of physical processes occuring in inner and outer space, measurements were carried of cosmic radiation spectra at various wavelengths.

Using the Maria magnetic spectrometer a cycle of experiments was performed to study the mechanism of generation of high-energy particles in circumterrestrial space, including the Earth's radiation belts.

A set of experiments on space materials science was performed using various technological facilities. In particular, fusing was carried out with the Gallar facility to obtain a high-quality gallium arsenide single crystal under microgravitational conditions. The Kristallizator device was employed on experiments to determine the thermophysical characteristics of the supercooling of melts.

As part of the programme for exploring the Earth's natural resources and studying the environment, visual observations, photography and spectrometric measurements of the land and water areas of the Pacific Ocean were effected.

Experiments were continued on evaluating the effects of a space environment on structural materials and radio-electronic apparatus components exposed for long periods under open-space conditions.

With a view to further studying the radiation situation in orbit and perfecting space dosimetry capabilities, experiments were carried out using the French Nausicaa apparatus.

In the field of medical control and the obtaining of additional information on the condition of the human organism at various stages of space flight, experiments were carried out using apparatus constructed by Australian experts. Investigations were made of the pschyo-physiological reactions and the operational activity of cosmonauts, and a comprehensive evaluation was made of the effect of weightlessness on the mechanisms controlling movement and the interaction of the organs of sight with the vestibular apparatus.

Biological experiments were performed for investigating the possibilities of deriving hybrid plant cells under conditions of weightlessness.

The Akustika and Shumomer experiments were carried out with a view to determining the parameters of the acoustic and electromagnetic effects emanating from functioning instruments and apparatus located in various sections of the piloted station.

IV. INTERNATIONAL COOPERATION

Under the terms of a commercial agreement and within the framework of the EUROMI-94 project, a citizen of the Federal Republic of Germany, the ESA astronaut U. Merbold, carried out on board the Mir station a programme of medical, technological and technical experiments prepared by ESA specialists.

On the basis of the agreement of 17 June 1992 between the Russian Federation and the United States of America concerning cooperation in the exploration and use of outer space for peaceful purposes and of the Executive Agreement of 5 October 1992 between the Russian Space Agency (RSA) and NASA on the collaboration in manned flights, the two bodies recognized the great potential for expanding joint space activities.

The joint programme in this field provides for flights by Russian cosmonauts and American astronauts on board the Space Shuttle and the Mir orbital station, and the conduct of an extensive programme of scientific experiments during the period 1995-1997. The implementation is anticipated of up to eight flights by Space Shuttle to the Mir station by American astronauts, with a total residence time in orbit of up to 2 years.

The operations carried out by the Russian side in this connection include the development, manufacture and delivery of docking mechanisms and sections, permitting the docking of the American Shuttle with the Mir station, together with the issue of reports, the training of American astronauts, the carrying out of Shuttle flights involving docking with the Mir station and the start-up of American scientific apparatus on the Spektr and Priroda modules.

Within the framework of the programme, February 1994 saw a Russian cosmonaut (Sergei Krikalev) fly on the Space Shuttle as a member of an international crew. At the Johnson Center (Houston, Texas) training is at present under way of a second Russian cosmonaut (Vladimir Titov), whose flight on the Shuttle is planned for February 1995.

At the Y.A. Gagarin Cosmonaut Training Centre two American astronauts (N. Thagard and B. Dunbar) are being trained for participation in a three-month flight on the Mir station in the period March-June 1995.

Work is simultaneously proceeding on the establishment of the international space station Alpha.

In 1993, with the participation of Russian experts, NASA carried out a review of the station project, with the aim of reducing its costs and accelerating its implementation, and at the same time transforming it into a genuine international venture. Studies showed that drawing on the more than 20 years of experience acquired by Russia in constructing and operating orbital stations and on its progress in the equipment field offers the possibility of solving the problems at issue, and the detailed plan of operations on the international space station confirmed by the RSA and NASA constituted the basis for the holding of a meeting of representatives of the RSA and managers of the space agencies of Europe, Canada, Japan and the USA - partners in the international space station project - which took place on 6-7 November 1993 at Montreal, Canada. The outcome of the constructive discussions held was the drafting of a joint statement by the Canadian, Japanese and European space agencies and NASA in support of the potentialities and advantages which will accrue to the international space station project through the participation of Russia and referring to the desire of the agencies to work for a formal invitation to Russia to join the international space station project as a full and equal partner.

Following upon the Montreal statement, approved by the international partners, regarding participation by Russia in the international space station project, the RSA in March 1994 proceeded jointly with Ministry of Foreign Affairs of the Russian Federation to discussions with the partner States in the project on the subject of a Protocol to the Intergovernmental agreement on an international space station, the effect of which would be to introduce appropriate amendments into the existing text in connection with the inclusion of Russia in the development of the project. This document established the basis, at international law, of cooperation between all partner States in the project and laid down the basic principles of collaboration. At present negotiations are proceeding at these talks on programme control, operation and use, and also on the principles of customs regulation and of the law to be applicable to the crew of the international space station.

At technical level, on the basis of design investigations on the overall structure of the international space station, a detailed plan of the sequence of assembly has been discussed and adopted as a preliminary project. In respect of the integrated Russian segment, basic principles and a draft design have been prepared, which will determine the configuration and structure of the segment.

In accordance with the programme of solar research under the international Coronas-I project, the Coronas-I unmanned universal orbital station was launched on 2 March. The purpose of the launch was to undertake comprehensive investigations of the sun, permitting the detection of active formations on its surface, the study of the effect of solar disturbances on the parameters of the terrestrial ionosphere and magnetosphere, and also analysis of solar cosmic rays.

The Coronas-I project was developed by Russian and Ukrainian experts in collaboration with specialists from Poland, the Czech Republic, Slovakia, Bulgaria, France, the United Kingdom, the Federal Republic of Germany, India and the United States of America.

On 25 January the German small satellite Tubsat intended for developing a system of precise location using stellar and solar sensors was launched into an Earth satellite orbit, along with the Meteor-3 spacecraft by a Tsiklon carrier rocket. The Tubsat satellite was separated from Meteor-3 on the 7th transit of the flight.

The Meteor-3 satellite carries the French Scarab 4-channel scanning radiometer for determining the characteristics of the Earth's radiation balance (development in the context of cooperation with France under the Radiation Balance project) and the German navigation system for measuring the motion parameters of a space device (PRARE project).

On 28 March the President of the Russian Federation B. Yeltsin and the President of the Republic of Kazakhstan N. Nazarbaev signed, in Moscow, the "Agreement between the Russian Federation and the Republic of Kazakhstan on basic principles and conditions governing utilization of the 'Baikonur' launch site". This Agreement was ratified by the Russian Parliament on 24 October.

The bilateral agreement in question provides for lease of the Baikonur launch site for a period of 20 years with the possibility of extending the agreement for a further 10 years.

V. PROPOSALS OF THE RUSSIAN FEDERATION FOR DEVELOPMENT OF INTERNATIONAL COOPERATION IN MATTERS OF THE USE AND EXPLORATION OF OUTER SPACE

Modern space science has opened up new prospects for solving many global problems affecting mankind. However, confined as it is within the closed compartments of State or individual international organizations, it is not fully exploiting its potential, which resides in the latest forms of equipment and high technology, and which could with great success be most widely applied not only in the space activities of the world community but also in many branches of the economy for the good of all mankind.

This being so, great topicality attaches to the possibility of considering the utilization of the achievements of space science in the interests of the world community in general, and in the solution of the urgent problems of the developing countries in particular.

The Russian Federation takes the view that certain prerequisites have emerged for developing a scheme of space activities on the part of the international community extending over a very long term, perhaps up to the year 2050, and programmes of space activities conducted by the world community over a period of 10 to 15 years under the supervision and guidance of the United Nations. The scheme should define the stages of integrating the potential of the space powers into a world space potential, accepting the fact that space is a "single home" for all, and anticipating that mankind will achieve economic unity while preserving national sovereignties.

During the first stage of establishing a world space community (perhaps up to the year 2000) under the aegis of the United Nations, the space science potential of the leading space powers and of already established space organizations should be applied to satisfying the requirements of the non-space countries, designs and programmes for the space activities of the world community should be worked out, and a start should be made on the systematic development of long-term space projects in the interests of solving, primarily, the global problems of mankind occurring as a result both of its own actions (catastrophic contamination of the environment, unrational use of raw materials, etc.,) and of an ongoing catalysing reaction by nature itself (various kinds of natural disaster).

The proposals of the Russian Federation for the conduct of collaboration during this stage, including collaboration with the developing countries, comprise the following:

- The launch of satellites built by other countries;
- The leasing of space objects;
- The provision of tracking services for spacecraft flights;
- The making available of data derived from the use of spacecraft;
- Joint design and construction of space facilities;
- Provision of facilities for the delivery of payloads to spacecraft;
- Joint monitoring of the overloading of circumterrestrial space and the compilation of a catalogue;
- Joint establishment of a unified space system for monitoring and warning the public of approaching natural disasters (earthquakes, typhoons, tsunamis, collisions with celestial bodies, etc.,) and the monitoring of emergencies at any point on the Earth;
- Joint scientific and commercial programmes;
- Exchange of space technologies;
- Training of specialists in the exploration and use of outer space and joint flights by cosmonauts on board manned spacecraft;
- The use of the Russian experimental base on behalf of foreign clients.

During this period Russia will be in a position to carry out comprehensive research and exploratory design work on:

- The scale and direction of space activities by the world community and the prospects for developing space technology during the first half of the 21st century;
- The establishment of principles governing the construction and form of a new generation of space facilities for national and international space projects;
- The definition of the principles and the methods of utilizing space systems, orbital unmanned and manned stations and the means of controlling them;

- Establishment of the principles governing the construction and technical form of a future international space transport system;

- A technical and economic analysis and evaluation of the effectiveness of the new generation of space facilities, and also the organizational and legal regime to govern space activities in the world community context;

- The identification of key scientific and technical problems and ways of solving them with the aim of securing promising developments.

The second stage (2001-2010) should be a stage of actual work on international space projects for the future and on the amalgamation of the space and economic potentials of States for the purpose of implementing such projects.

Russia regards the following international space projects as enjoying priority and basic status:

- The future generation of international communication systems, television broadcasting, navigation, remote sensing of the Earth, ecological monitoring, and warning of natural disasters;

- Research on outer space for scientific and practical purposes, flights to Mars and other planets;

- The industrial production of unique materials in space;

- Monitoring of orbits and their cleansing of space debris;

- The use of solar energy to meet the practical requirements of mankind in space and on Earth;

- The deposit of particularly dangerous radioactive wastes at burial sites in space.

In the course of work on such projects the following institutions could be established and successfully operated under the auspices of the United Nations:

- A global system of communications and television broadcasting;

- A global system of ecological monitoring;

- A global system of natural resource control;

- A global system of military security;

- A global system of navigation;

- A global system of warning of natural disasters;

- A system for the disposal of particularly dangerous radioactive wastes;

- A system for the removal of space debris from orbits;

- International orbital stations;

- Space solar power stations;

- Spacecraft for flights to Mars and other planets;

- New apparatus for the delivery of payloads and control of spacecraft.

Following many years' experience of the development, construction and operation of space facilities with various purposes, and in the light of the complexity and multiplicity of the problems to be solved by international space systems, together with the high cost of such systems, it is considered advisable right from the start to base operations relating to international space projects on the following approaches and principles:

- Equality of rights and mutual benefits derivable from space activities;

- Maximum utilization of the space potential and space infrastructure of all countries of the world;

- The achievement of unification, standardization and rational integration in creating space facilities;

- The introduction of a rational type-classification for light, medium and heavy space facilities;

- Modularized construction of space facilities;

- Automation and "autonomization" of spacecraft control processes;

- Microminiaturization and enhanced reliability and lifetime of equipment thanks to the use of the latest technologies;

- The establishment of multi-purpose space platforms;

- Re-use of space equipment;

- Technical support, servicing, assembly and repair of space facilities in orbit;

- Rationalization of the number of launches of space objects;

- Transmission of the achievements of space science to the world economy;

- Prohibition of the availability of space high technology to the aggressive military preparations of certain States.

During the third stage (2010-2030) and later there should follow the practical implementation of international space projects and the conduct of research with a view to creating a new generation of space technical equipment.

Unification of the efforts of the world community in the field of space activities will lead to a concentration of the intellectual, scientific, technical and economic potentials of States, and to new successes in space science in enhancing the quality of life on Earth and promoting the penetration of mankind into space; it will also yield definite advantages as regards saving material, technical and financial resources, the application of the achievements of space science in the interests of all peoples and all States, and the possibility of implementing particular space projects which, thanks to their high cost, do not today lie within the reach even of the wealthiest individual countries. In addition, an expansion of international cooperation in matters of research and use of outer space for peaceful purposes under the auspices of the United Nations will ensure the application of high-technology space equipment and of space facilities only for the good of all peoples, to the exclusion of their use for aggressive military purposes.

As regards cooperation with the developing countries, the Russian Federation considers that there exists today a strong capability on the part of Russian space science in the field of accelerating the development of the economies of these countries and meeting their requirements.

Of great promise for implementation in the developing countries are services in the areas of remote sensing of the Earth and of mapping work. At the twelfth International Cartographic Conference held under United Nations auspices in Thailand in 1991, the Russian space photographic survey was recognized as the best in the world. Developing countries may place orders for photographs of their cities and territories, for purposes of town planning, the establishment of agricultural, forestry and water surveys, and also operational information in various ranges of the electromagnetic spectrum in the interests of rational utilization of natural resources. For the receipt of such information it is possible to construct and market stations located on motor vehicles, ships or other carriers. Such stations will be able to receive meteorological data from Meteor-3M, NOAA (USA), Elektro, GOES (USA), GMS (Japan) and Meteosat (Europe), and will certainly be of interest to the developing countries.

Efforts are at present being deployed in Russia to create new space systems, including a space system for remote sensing of the Earth and a global space system for giving warning of and monitoring emergencies and disasters.

In view of the great interest on the part of the developing countries in exploring the natural resources of their territories and of the exposure of most of them to various catastrophic phenomena (earthquakes, tsunamis, etc.), it appears extremely likely that they will participate in work on such space systems.

The achievement of a certain level of throughput capacity by new equipment in satellite communication and broadcasting systems.

Through the large-scale production of navigational equipment available to consumers and capable of operating on signals from the space navigation systems GLONASS and GPS and also of navigational and communications terminals for monitoring the movement of vehicular and other traffic, it would be possible to meet the requirements of the developing countries for these facilities.

Russia can offer the developing countries a wide range of services in the field of the delivery of payloads into orbit. At present, the Proton, Molniya, Soyuz, Tsiklon, Cosmos and Zenit carrier rockets are available for this purpose on mutually favourable conditions, since the reliability and launch costs of these rockets compare favourably with those of their foreign counterparts.

At present Russia has enormous experience of manned programmes, and the training and long-term missions of cosmonauts, which may be successfully applied likewise in the interests of the developing countries. For this purpose there is available the Mir space station, on which cosmonauts of many countries of the world have already worked.

Of great interest for Russian space science is the possibility of delivering payloads from points on the planet's surface which are optimal in terms of power and weight. Thus, a Proton rocket launched from the equatorial regions of the Earth will be capable of delivering a payload of up to 4 tons into a geostationary orbit (in comparison with 2.4 tons when launched from the Baikonur launch site).

Developing countries located in the equatorial zone can exploit their advantages in this respect for the construction and operation of launch sites.

Russian space science is a master of high technology, which can also be used by the developing countries for their own scientific, technical, social and economic progress. However, Russia can make available these technologies only for civilian purposes, primarily in the field of materials and components.

Along with the above-mentioned forms of cooperation, consideration may be given to other aspects of space activities of interest to the developing countries and offering benefits to both sides.

UNITED ARAB EMIRATES

[Original: English]

The Department of Geology, in collaboration with the Department of Physics at the Faculty of Sciences of the United Arab Emirates University, is preparing a programme of cooperation for the study of harmful ultraviolet rays of the Sun, an other studies related to global climate change.

The Department of Geology at the University has also expressed the wish to develop its remote sensing unit into a regional centre to serve the South-East region. Negotiations had (have) been conducted in this respect with ESCWA, in connection with the United Nations Programme on Space Applications.

The Department of Mechanical Engineering of the United Arab Emirates University is preparing three projects in the field of microgravity space science. Experiments will be flown on the space shuttle Spacehab-06 mission in 1996. The experiments are:

- Crystal Growth of Bismuth Germanate using the Float Zone Furnace:

  Single crystals of BGO ($Bi_{12}GeO_{20}$) and their solid solutions are wide band-gap, high resistivity semi-insulators that are also piezoelectric, photoconductive, acousto-optic, magneto-optic and optically active. As such, they have found widespread applications in optical information processing and computer components such as spatial light modulators and photorefractive volume holographic optical elements. Bismuth Silicate (BSO), Bismuth Germanate (BGO) and their solid solutions have created a great deai of interest in the forms of bulk crystals and epitaxial films for opto- and acousto-electronic applications in integrated devices. These materials and their solid solutions in single-crystal form can be used as substrates for thin-film epitaxy devices for optoelectronic applications in integrated optics.

- Crystal Growth of $CdGeAs_2$ using the Float Zone Technique:

  The goal of the present research is to study float zone growth processes of $CdGeAs_2$, which is one of the ternary semiconductors which crystallize in the chalcopyrite structure. Possible applications of this material include non-optical devices, photovoltaic detectors, luminescent diodes and solar cells. $CdGeAs_2$ semiconducting compounds contain highly volatile components and pose a variety of problems for crystal manufacturers. Since $CdGeAs_2$ melts congruently and has a relatively low equilibrium vapour pressure of the components at the melting point totalling 76 torr, the direct fusion method has been found to be the most desirable. Material was synthesized from elemental Cd, Ge and As, or from Cd_3As_2, Ge and As of 5 or 6 N purity in quartz reactors coated with pyrolitic graphite. This material has a low melting point of 670°C.

- Thermocapillary Convection in InBi Encapsulated with Silicone, Glycerin and Krytox:

Utilizing a low melting point intermetallic compound as a model material, four samples, three with liquid encapsulants and one control sample filled with Argon were modelled using finite element techniques. Preliminary results from a Liquid Encapsulated Melt Zone (LEMZ) experiment flown in the Spacehab-01 module on STS-57 found that stable molten zones of relatively large lengths could be formed and translated. It was reported that the encapsulants allowed for easier control of the zone and more uniform diameter crystals.

Spinoff Benefits of Space Activities

During the past fifteen years, space scientists tried to understand the interface phenomena in microgravity. Lessons learned from space research were discussed at the Interfacial Phenomena in Porous Medium in the United Arab Emirates in November 1994. It was found that such a phenomena plays a major role in the oil industry. By helping the local industry understand this problem, the oil recovery in the United Arab Emirates will be enhanced. Experts in space science from Belgium, Canada, France and Russia were present. The Workshop was supported by the United Arab Emirates University, the European Space Agency (ESA), the German Space Agency (DARA), the local oil companies such as ADNOC, ADCO, ADMA-OPCO and international oil companies such as TOTAL and Schlumberger.